AGRICULTURAL Research

MAY-JUNE 1953

LIGHT and Plants

Story on Page 3

AGRICULTURAL
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GUINEA-PIG PLANTS under carbon-arc lamp are soybeans. Responsive and easy to handle, they help research men learn how light affects plant processes. *USDA photo by Forsythe.*

Report on research objectives

The Agricultural Research Policy Committee has submitted to the Secretary of Agriculture a report entitled "Agricultural Research—A Key to Strengthening Our American Way of Life." It deals with the long-time objectives of agricultural research in terms of 18 broad questions, presented as "today's inventory of the most serious shortages in our supply of agricultural knowledge." Copies of this report are available on request from the Agricultural Research Administration.

Fight against vesicular exanthema

On page 6 is a report on the swine disease atrophic rhinitis, along with unwelcome news about two diseases of sheep. A nationwide program is under way to eradicate another disease of hogs, vesicular exanthema. Similar to foot-and-mouth disease, it affects only swine. It has appeared in 40 States since mid-1952, and at this writing areas in 16 States are under quarantine. Disposal of affected swine, good sanitation, and cooking of garbage fed to hogs are essential weapons in fighting this serious threat to hog production. M. R. Clarkson, deputy administrator of ARA, is in charge of USDA's part in cooperative State-Federal action to combat the disease. A report on the campaign against vesicular exanthema will appear in an early issue.

Reprint at will

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AGRICULTURAL RESEARCH ADMINISTRATION
United States Department of Agriculture

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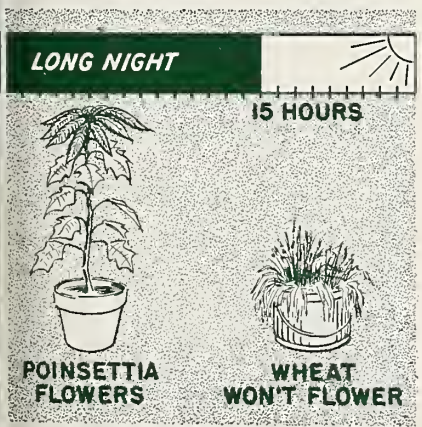
New *Light* on plants

Pioneering research by USDA scientists has just revealed new facts about the mysterious ways in which light regulates plant behavior.

Why will Biloxi soybeans bloom in Alabama but not in Iowa? What makes corn seedlings put out roots at just the right point below the soil surface, whether the grains are planted deep or shallow? Why do certain onions fail to bulb in one locality and produce well in another?

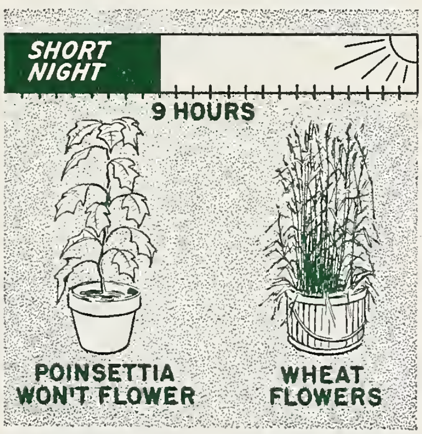
The answer to these seemingly unrelated questions lies in the same mystery of nature—a certain reaction to light. ARA scientists have steadily pushed deeper into this basic process of living plants, making some of the most important of their discoveries during the last year.



LONG-NIGHT plants, such as poinsettia, hemp, millet, chrysanthemum, and many of our fall-flowering weeds, need long daily dark periods for flowering. Wheat remains vegetative.

We know, of course, that plants respond to light in many ways. Long ago we learned that plants use light to make food by photosynthesis. And everyone is familiar with the reaction — called phototropism — that causes plants to bend toward the light. But the effect of light in controlling such responses as flowering is a relatively recent discovery.

The pioneers were two USDA scientists, W. W. Garner and H. A. Allard. In 1920, they found that Maryland Mammoth tobacco came into flower only when the light period each day was kept short and the dark period was kept long. It seemed to Garner and Allard that something happened in the plant during the light period to bring about this result, so they gave this response the name photoperiodism.

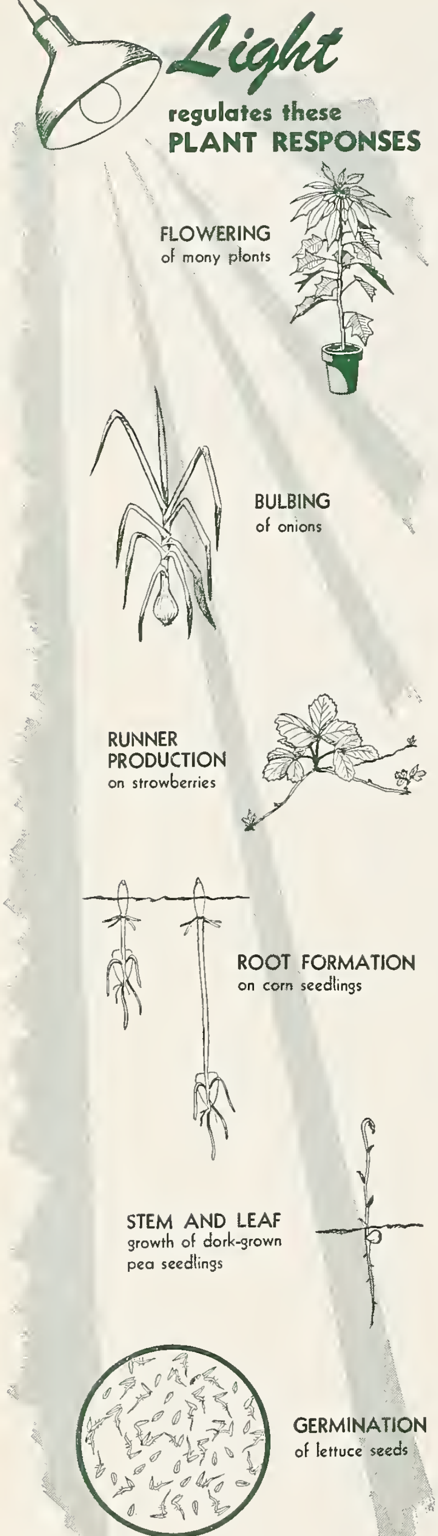


SHORT-NIGHT plants, such as wheat, barley, rye, beet, spinach, and certain summer-flowering weeds, can flower only when daily dark periods are short. Poinsettia stays vegetative.

Plants that flowered sooner when the days were shortened were called short-day plants, and those that blossomed only when the days were lengthened were called long-day plants. Others that apparently were not influenced at all by the length of day were referred to as indeterminate types.

But a later development proved that it's the duration of darkness—not of light—that controls flowering. The long-day plants are better described as short-night plants, because they won't bloom if the dark periods run too long. And the short-day plants are really long-night plants, since they refuse to flower if the darkness is too short. The importance of darkness was clear when the scientists found that breaking the dark period near the middle, even for a short time, will prevent flowering of long-night plants or cause flowering of short-night plants.

It's now known that flowering isn't the only response that works this way. Bulbing of onions and production of



runners on strawberries also depend on length of night.

Photoperiodism soon helped to solve many problems in the field and greenhouse. Wheat breeders were among those who used the discovery. Breeding for a new variety must be carried through several generations. We now get 3 generations a year by growing 2 in the greenhouse, but it takes artificial light—shortening the periods of darkness—to make wheat produce flowers out of season.

Chrysanthemum growers learned to delay blooming with several extra hours of artificial light each day, so that early varieties could be used through fall and winter. In recent years, growers have found that a single hour of light near the middle of the night gives the same effect.

Tropical sugarcane producers use light to prevent fall flowering. Fall is the only time of year when all conditions, including night length, are just right to bring out blooms. This cuts yields, because stalk growth stops when flowering begins. All that's needed is a little artificial lighting near the middle of the night for 2 or 3 weeks each fall.

Ordinarily, of course, we can't change the day-length of a region to fit the needs of a field crop. But we can change the crop or choose a variety to fit the region, because night (or day) length follows about the same pattern from year to year in a given place. For example, we now have nine distinct groups of soybeans. Each group is adapted to a cross-country belt about 100 miles wide. The Biloxi variety of Group 8 thrives along the Gulf Coast but doesn't do so well 300 miles farther north in Arkansas.

As the years went by, research continued to reveal new things about photoperiodism. You will recall that flowering can be prevented by exposing a long-night plant to ordinary white light during the middle of the dark period. White light, of course, is a mixture of all the colors of the spectrum. Scientists now decided to see how plants would react when separate colors, or wave length bands, were substituted for white light.

Tests showed red light was by far the most effective band—so effective that using it on long-night soybeans for less than half a minute in the middle of the 14-hour dark period was enough to prevent flowering. And red light also turned out to be the most effective band in causing the flowering of short-night plants when applied near the middle of the dark period. Scientists now saw that both groups of plants have the same photoperiodic mechanism.

What sort of mechanism is it? Research had proved that the response worked through the leaves of plants. Apparently, some special substance in the leaves was absorbing the light. No one could explain the chemical structure of this substance, but the fact that some colors were more effective than others indicated that it must be a pigment.

Scientists began to find that red light regulates still another group of plant responses. Although they aren't affected by night length, as are flowering, bulbing, and runner production, the new responses do react to red light in just the same way. Such a response tells corn seedlings when to put out permanent roots. Similarly, small amounts of red light can regulate the stem and leaf growth of pea seedlings otherwise grown in the dark. But the latest finding—and one of the most incredible of all—is a reversible photoreaction that controls lettuce seed germination.

The discovery was made by H. A. Borthwick, S. B. Hendricks, M. W. Parker, E. H. Toole, and V. K. Toole of the Bureau of Plant Industry, Soils, and Agricultural Engineering. These scientists decided to look into a published report that the germination of

ıe variety of lettuce seed was pro-oted by exposure to red light but ɜld back by infrared radiation. The ·sponse to red light suggested a rela-on to photoperiodism, and that's ex-ɜtly what it turned out to be.

But the scientists unexpectedly ɔund more. Red light caused the ny plant in a lettuce seed to awake; soon sprouted if given no further eatment. Infrared rays, on the ther hand, put the plant back to eep; it failed to sprout when infra-ɜd was used on the seed soon after xposure to red. The response could e pushed either way by changing the ght. Now, not one pigment but two ɜemed to be involved.

This opened a new approach to hotoperiodism. Red radiation was ıe most effective part of the spectrum ot only for control of flowering but lso for promotion of lettuce seed ger-nination. Infrared held back germi-ation but had never been recognized s effective in control of flowering. Iad something been missed?

It had. In retests with the photo-ɪeriodic weed cocklebur, the scien-ists used enough red light in the mid-le of the dark period to prevent flow-ring—then followed up at once with nfrared. The cocklebur bloomed, ndicating that infrared rays had un-one the effect of the red. Infrared, hen, has the same effect as a long ıark period. It was now apparent hat the reversible reaction observed n seed germination also works in the egulation of flowering.

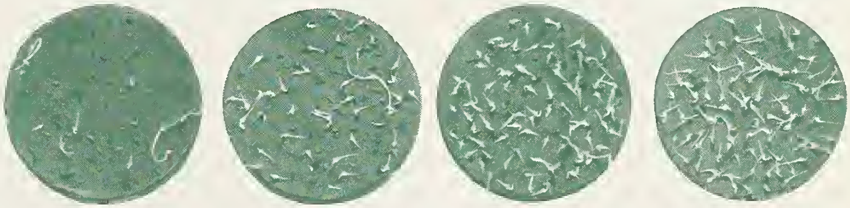
There are many unanswered ques-ions. Plant scientists believe re-earch in photoperiodism and related ɔrocesses may give us new insight in-o the basic processes of plants, ex-ɔlain some of nature's mysteries, and ɔrovide a tool for plant breeding and ɜrop production. It may also lead to levelopments in animal research, ɜince reproduction in goats, turkeys, ınd other species has been shown to lepend on night length.

REVERSIBLE PHOTOREACTION

Germination of Lettuce Seeds

Red Light: makes these lettuce seeds sprout

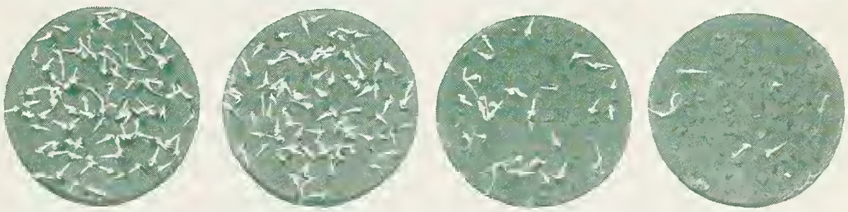
½ minute | 2 minutes | 8 minutes | 16 minutes



RED LIGHT was used on seeds previously held in dark at 20° C. on wet blotters. After exposure for times shown, seeds were held in darkness 2 days at 20° and sprouts were counted.

Infrared: prevents the seeds from sprouting

½ minute | 2 minutes | 8 minutes | 16 minutes



INFRARED was used for times shown on seeds previously given red light for 10 minutes to make sure they were ready to sprout. After infrared, seeds were held in dark as were those above.

Alternate Red, Infrared: last exposure rules

R | R I | R I R | R I R I

REVERSIBLE photoreaction was apparent as alternate red and infrared exposures counteracted each other. When red was used last, seeds sprouted. Using infrared last prevented sprouting.

ATROPHIC RHINITIS

Veterinarians find parasite may cause hog-snout disease

A lead on the cause of atrophic rhinitis, and a practical way for veterinarians to find many of the affected swine in a herd, have been reported by scientists of the USDA Bureau of Animal Industry.

Recent studies indicate that parasites of the trichomonad family may bring on this disease, which has now appeared in hog-raising areas throughout the country. Various species of one-celled organisms called trichomonads cause several diseases of man and animals. One of the best known is bovine trichomoniasis, a venereal disease of cattle.

Zoologists L. A. Spindler, D. A. Shorb, and C. H. Hill conducted the rhinitis tests at ARA's Agricultural Research Center. These scientists found that pigs contracted the disease when nasal discharges containing bacteria, fungi, and trichomonads were put into the nostrils. Other animals given similar discharges—in which the trichomonads were dead—weren't troubled with rhinitis.

A survey by the Iowa Agricultural Experiment Station disclosed trichomonads in the snouts of 80 percent of the affected pigs but in only 2.8 percent of those not affected. Previous research had shown no evidence that the disease is caused by bacteria or a filterable virus.

Sneezing is the most common symptom of atrophic rhinitis. There may also be a bloody discharge from the nose, and nasal irritation sometimes causes pigs to rub their snouts against posts or into the ground. The nasal bones waste away, giving a crooked-nosed appearance in bad cases.

But many affected animals don't show these positive signs. ARA veterinarians R. D. Shuman and F. L. Earl found, however, that they could spot the disease more than 75 percent of the time by checking the nasal passages with a lighted instrument called an otoscope. A castrating trough was used to restrain pigs during the examination, and larger animals were held in a breeding chute that was equipped with a yoke in place of the usual gate.

Although this method is not completely accurate, it does offer a practical means of getting rid of many affected animals and of checking replacements. Shuman and Earl suggest that breeders would be wise to have a veterinarian examine any stock they plan to buy.

How serious is atrophic rhinitis? Although the research men still have no definite evidence on this point, unthriftiness and even high losses in some herds have been reported.

Research is continuing on the cause, diagnosis, control, and economic effects of this disease.

Two virus diseases of sheep make first U. S. attacks

Blue Tongue. The virus of blue-tongue disease has infected some 350,000 sheep in California. Symptoms that appeared earlier among flocks in Texas and Utah as "sore muzzle" are also assumed now to indicate blue-tongue infection. These are first evidences of the arrival of this disease in the United States.

Work to devise effective control and eradication measures is under way. R. A. Alexander, director of veterinary services for the Union of South Africa and world authority on blue tongue, is coming to this country at the USDA's invitation. He has been asked to help in a study of the disease as it exists here.

It was Dr. Alexander who determined that the California sheep were suffering from blue tongue. He found the virus in chicken-embryo cultures taken from diseased animals and sent to him in South Africa by the University of California.

Blue tongue is spread among sheep by biting insects, such as sand flies. It sometimes mildly affects cattle. There is no evidence that it can be spread by contact, and how the virus was introduced into the United States is not yet known.

Largely confined to Africa, blue tongue has caused heavy losses to South African sheep raisers since 1876. Mortality rates there have run as high as 90 percent. So far, the disease has proved less virulent in this country, and the mortality rate has been considerably lower.

Scrapie. Within the past year, another virus disease, also new to the U. S., has appeared among sheep in California, Illinois, and Ohio. This is scrapie, which affects the nervous system of sheep. No cure is known, and infected animals usually die in a few weeks or months.

Scrapie is rarely seen in very young sheep, since its normal incubation period is 18 months or longer. The disease makes sheep restless and excitable. They often walk unsteadily and suffer from thirst and severe itching. Suspected cases of scrapie should be reported immediately to State or Federal officials.

On Guard against alien plant pests

by E. R. Sasscer

Bureau of Entomology and Plant Quarantine

Insects destroy more than 3 billion dollars worth of our farm crops every year. Plant diseases take millions more. But these losses would be much greater if we had no safeguards against the introduction and spread of destructive insect and plant-disease immigrants.

Our safeguards are the plant-quarantine laws, which authorize the Secretary of Agriculture to regulate the entry and interstate movement of insects and carriers of insects and plant diseases.

FIRST LINE of defense includes 60 ports, border stations, and inland traffic centers.

INSPECTORS make careful checks to prevent dangerous insects and diseases from coming in.

To enforce these laws, the Bureau of Entomology and Plant Quarantine has a well-trained corps of plant-quarantine inspectors. They are stationed at maritime and border ports of entry, where they examine baggage, boxes, plants, food—anything that might harbor a plant pest. They scrutinize airplanes, trains, automobiles, parcel post packages. Last year, for example, they inspected 80,000 planes and 50,000 ships. One out of every four carried plant contraband. Approximately 15,000 interceptions of insects and plant diseases were made.

Some of our worst pests have been with us a long time—before our quarantine laws were enacted. The gypsy moth, for example, was brought from Europe in 1869 by an amateur entomologist in an attempt to interbreed it with the silkworm. Chestnut blight, which has completely destroyed our valuable American chestnut trees, came from Asia before 1904. The common barberry, which carries stem rust of grain, was brought from Europe in colonial times as an ornamental plant. The oriental fruit moth, a pest of peaches and other fruit, came over in the Japanese cherry trees that blossom colorfully each spring around the Tidal Basin in Washington, D. C.

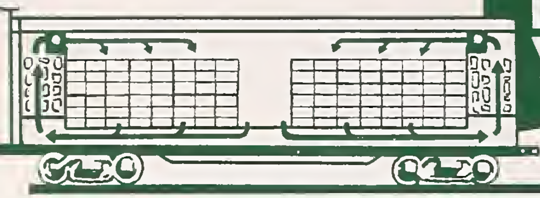
But thanks to plant quarantines, many equally destructive pests of agriculture have been kept out of the country. The durra stem borer, a native of southern Europe and Africa potentially more damaging than the corn borer, could ruin our corn and sorghum crops. The citrus blackfly is just over the border to the south; citrus trees heavily infested with this insect bear little marketable fruit. Fruitflies from the Orient, Mediterranean countries, and the South Pacific are all potential threats to our fruit and vegetable crops.

In spite of our organized vigilance, some serious plant pests have succeeded in getting through. When this happens, the domestic quarantine system can go into action to eradicate them or prevent their spread. The Mediterranean fruitfly and citrus canker, both of which threatened our citrus industry, were eradicated. The gypsy moth has been confined to a relatively small area in the northeastern U. S. for many years.

Quarantine regulations make it possible for private and Government importers to bring in under adequate safeguards huge quantities of plants and plant materials. In 1951, for example, we imported more than half a billion bulbs and nearly 4½ million items of nursery and greenhouse stock valued at more than 10 million dollars. Cooperation has steadily improved, as shippers, packers, travelers, and the general public have become more aware of our foreign and domestic quarantine laws and the inspections necessary to enforce them.

Our country is entitled to the best possible protection against the introduction or spread of destructive crop pests. Through plant quarantines. we are insuring the future protection of our national food supply and natural resources.

Mr. Sasscer, head of USDA plant quarantines, has directed various phases of this program since 1912.



FRUITS and VEGETABLES

To Market–

CALIFORNIA oranges, Minnesota potatoes, Florida sweet corn—many fruits and vegetables now get to market in better shape at lower cost because of research.

Produce losses between farm and market average about 20 percent and run into hundreds of millions of dollars yearly. ARA studies are helping to prevent this waste.

Transit tests have shown orange shippers how to save as much as $50 a car on cross-country rail trips by ventilating with cool mountain air instead of filling bunkers with ice . . . Single sheets of paper under floor racks and or freight car walls now help protect potatoes from winte cold. Badly skinned early potatoes heal better and stay healthier when shipped at an ice-saving 50° to 55° rathe than an over-refrigerated 40° . . . Ice-water precooling quickly drops sweet corn temperatures, puts roasting ear on city tables while the corn's still fresh and sweet.

These are samples of research on handling, transporta tion, and storage of horticultural crops. This work, aidin

TEST PARTY checks with weatherman at Yakima, Wash., before start of cross-country transit test of apples. On trip, research men watch how load reacts to changes in heating and icing, ventilation, and other variables. W. H. Redit (left) handles engineering side of transit studies.

TEST CAR is rigged with distant-reading electric thermometers. Th wires run outside to the roof of the car so scientists can take reading en route without upsetting conditions inside. Temperature, which con trols ripening and decay, is the big problem in shipping fresh produc

READINGS of temperatures in test cars are taken 2 or 3 times daily during the trip. Such studies have resulted in better icing and heating services at lower cost, and in development of improved cars and equipment. This ARA program also covers shipments by truck, plane, and ship.

RESEARCH men work up test figures en route. Members of test party l in caboose or business car during trip, which may run 3 to 10 dc All concerned, from growers to wholesalers, cooperate with scient in these studies, and regular commercial produce shipments are us

n better shape at lower cost

rower and shipper alike, is conducted by the Bureau of lant Industry, Soils, and Agricultural Engineering.

The Bureau's scientists must learn what's best for fresh uits and vegetables en route to market, then develop conomical ways to maintain proper shipping conditions.

Laboratory research is followed by actual transit tests ee pictures). Growers, shippers, railroads, distributors, quipment manufacturers—all give a cooperative hand in nding the right answers and putting them into practice.

RECORDING thermometer, placed in a crate of produce, can tell the temperature story of a trip.

ADING is carefully supervised. Thermometer bulbs stuck in apples easure temperatures in various parts of car. Since air conducts heat cold from car bunkers to produce, good circulation is necessary to aintain even temperature in load, from top to bottom and front to back.

HEATERS are put in bunkers to protect apples during cold trip over the mountains. Thermostat on this new alcohol heater controls operation. Old-style charcoal heater needed frequent refueling, often overheated apples. Transit problems involve equipment, packaging, loading methods.

ING may be needed if shipment moves into warm-weather zone. As a ult of research, railroads now offer varied icing service according the type of load and weather conditions. This can mean big savings shippers. Ventilation alone may give refrigeration in cold weather.

BUYERS at New York Fruit Auction look over apples from test shipment already checked by researchers. So far, transit studies have been made on about 30 commodities. This research includes work on post-harvest diseases, storage, handling and packaging, and quality evaluation.

Chemical series tested on apples

A full series of 15 phenoxyacetic acids has been studied for the first time in recent ARA trials to compare their physiological effects on mature apples. Best known member of this chemical family is 2,4–D.

The series includes monochloro, dichloro, and trichloro phenoxyacetic-acid compounds. A tetrachloro form of the acid and the pentachloro form were also tested.

Several of the chemicals are proven plant-growth regulators. For example, 2,4–D is famous as a weed killer and also retards drop of some apples and citrus fruits. The 4-chloro acid keeps tomato flowers from falling, and 2,4,5–T is a fruit-ripening agent and harvest spray for apples.

There is a possibility that other phenoxyacetic acids may delay dropping in apple varieties for which effective stop-drop sprays are not now available. More research is needed, however, to make use of these compounds practical for growers.

Apple varieties included in the test were Grimes Golden, Red Delicious, Golden Delicious, Northern Spy, York Imperial, and Winesap. The chemicals were applied about 3 weeks before normal harvest dates. Here is a summary of results:

3,4,5–T—highly effective on all six varieties. Sixty percent or more of treated apples stayed on the trees a month after the usual harvest date.

4-chloro and 2,5–D—highly effective except on York Imperial.

3-chloro, 3,4–D, 2,3,4–T, and 2,4,5–T—worked well on four varieties. Only 2,4,5–T had been previously reported as effective.

2,4–D—effective on York Imperial and Winesap, as already known.

2-chloro—good only on Winesap.

2,3,5–T—moderately effective on all six varieties.

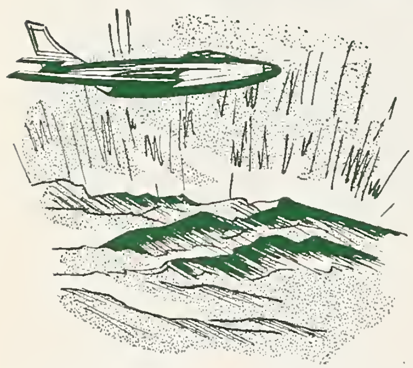
Others tested (2,3–D, 2,6–D, 3,5–D, 2,3,6–T, 2,4,6–T, 2,3,4,6,-tetrachloro, and 2,3,4,5,6-pentachloro)—little or no effect.

Some of the chemicals, especially 3,4–D, 2,4,5–T, and 3,4,5–T, seemed to speed up ripening.

These preliminary tests were made by P. C. Marth, J. W. Mitchell, and W. H. Preston, Jr., of the Bureau of Plant Industry, Soils, and Agricultural Engineering.

One aim was to determine whether the biological effect of the compounds could be predicted from their chemical structure. Some acids behaved about as expected. Others proved more potent than anticipated, indicating that present ideas of how chemical structure is related to growth-regulator action may need revision.

Pine-gum acid may help Arctic flying



If current research can bring down the cost of getting pinic acid from turpentine, pine-gum farmers in the Southeastern States should have a new market for their crop.

Pinic acid can be made into synthetic lubricants that will help jet-aircraft engines start and keep them running at 75° below zero. Research men see a future for it also in making improved plastic products.

Chemists of the Office of Naval Research and the ARA's Bureau of Agricultural and Industrial Chemistry have converted alpha-pinene, one of the major constituents of turpentine, into pinic acid. Then they combined the acid with high-boiling alcohols to make special lubricants required for sub-zero operation of gas-turbine engines, aircraft instruments, hydraulic landing and control gear, and other equipment.

These lubricants are outstanding in their ability to stay fluid and efficient at very low temperatures.

The new pinic-acid lubricants are needed to ease aircraft operating difficulties in the Arctic. Conventional petroleum products become gummy at extremely low temperatures, and at present military aircraft in the Far North frequently resort to imported castor oil for lubrication.

But the U. S. produces plenty of turpentine, and making lubricants from its pinic-acid derivative should be possible at relatively low cost. The lubricants and pinic acid itself have a number of industrial as well as military uses.

Although making pinic acid is fairly simple on a test-tube scale, laboratory methods are not suitable for large-scale commercial production. Armour Research Institute is now under contract to test one possible commercial method, and the Georgia Institute of Technology is expected soon to try another.

Meanwhile, the Bureau's Southern Regional Research Laboratory in New Orleans is exploring further possibilities for making pinic acid economically in large quantities.

Today's cotton has Better Fiber

Cotton as the farmer grows it has greatly improved during the past dozen years in two important properties—fiber length and fiber strength. This is confirmed by a recent study, which compared the quality of fiber in the 12 million bales of cotton grown in 1939–41 with that of the 14-million-bale production of 1949–51.

In the decade spanned by the survey, average fiber length increased 6.1 percent, from 0.98 inch to 1.04 inches, and fiber strength rose 6.6 percent, from an index of 6.78 to 7.23. These figures mean that today's cotton is easier to process and makes better yarn and fabric.

The survey was made by J. E. Hite, cotton agronomist of the Bureau of Plant Industry, Soils, and Agricultural Engineering. Fiber length was measured on a Fibrograph and fiber strength on a Pressley strength tester. The years 1939–41 were chosen for the survey as the earliest 3-year period for which adequate cotton-fiber measurements by these instruments were available. Here are some of the findings:

Deltapine varieties (of which over 3 million bales were grown in both test periods) increased in fiber length from 1.02 to 1.07 inches and in strength index from 6.84 to 7.24. The most dramatic increase in fiber strength—from 6.54 to 8.00—was found in Acala cotton grown under irrigation in California.

Biggest gains in length were made in Alabama, Georgia, Missouri, Arkansas, North Carolina, and Louisiana, where increases averaged 9.5 percent. Western cottons showed the largest improvement in fiber strength, with a jump of 22.3 percent in California and gains in Oklahoma, Arizona, Texas, and New Mexico averaging 8.75 percent.

Many of the improved varieties in wide use today were either just being introduced or were still in breeders plots 10 years ago. One of them is Empire (nearly half a million bales produced annually during 1949–51), and another is Coker 100W (about 2 million bales grown annually). These and other new varieties, as well as improved varieties of older cottons, such as Hibred, Mebane, and Rowan, contributed to the over-all improvement noted in the survey.

Plant scientists see these 10-year gains as only the beginning of cotton-fiber improvement that is possible through research.

Early dust stops stored-wheat insects

A good time to attack insects in farm-stored wheat, say ARA entomologists, is right after harvest, when bins are being filled. Farmers can do the job easily with a new dust mixture recently put on the market.

It contains 1.1 percent piperonyl butoxide and 0.08 percent pyrethrins. This mixture won't harm animals or humans if used as recommended. Insecticidal dusts have been used for years to protect seed wheat, but the new mixture is the first one available that is safe to use on grain intended for food or feed.

Wheat is not normally infested in the field. The insects move in, from hiding places in farm bins or nearby, after the grain is stored. They can multiply in stored wheat more than 40 times in 4 months.

That's why wheat should be dusted as it is put into the bins. In ARA tests on Kansas farms, the insecticide was applied at the rate of 75 pounds for each 1,000 bushels of grain. This gave excellent protection from insects for 3 months after harvest. Also, the dust caused no downgrading of the wheat when it was tested after storage by the Kansas State Grain Inspection Department.

Multi-bug protection for alfalfa

Modern insecticides give farmers some excellent weapons against many pests of alfalfa, a crop that provides more than a third of our hay.

It's not economical, of course, to use a different bug killer for each kind of alfalfa pest. But ARA entomologists are finding that use of proper formulas and schedules could make one insecticidal spray effective against several insects.

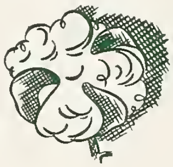
For example, methoxychlor will control potato leafhoppers, alfalfa weevil larvae, and spittlebug nymphs. Since this compound leaves no harmful residue, it can be used on both hay and seed alfalfa.

DDT is recommended for alfalfa weevil larvae, lygus-bug nymphs, pea aphids, armyworms, thrips, and leafhoppers. Toxaphene is effective against lygus-bug nymphs, grasshoppers, and armyworms. Because of the possible hazard from residues, DDT and toxaphene should be used only on alfalfa intended for seed.

Applying these insecticides at the

right time, in proper concentrations, offers the possibility of controlling a variety of alfalfa pests at relatively low cost. However, practical farm use of multi-purpose bug killers depends upon using formulas adapted to the insects in a given locality, and applying them at times that are suited to local crop conditions. Considerable work must still be done before specific recommendations can be made for use in particular areas.

Planting cotton by thermometer



Can soil temperature tell a farmer when to plant cotton? California growers producing seed of new Acala strains say it can. Now research teams in several States are trying to find out whether this guide to cotton planting will work for them.

Trials by George Harrison at the Shafter (Calif.) field station of the Bureau of Plant Industry, Soils, and Agricultural Engineering showed that certain soil temperatures at planting insured a good stand of cotton. As a result of his work, some California growers are now planting—if the weather forecast is favorable—when soil temperature 8 inches below the surface at 8 o'clock in the morning is 58° F. for 3 successive days.

This spring, technicians across the Cotton Belt have been poking soil thermographs and hot-bed thermometers into the ground and planting different varieties of cotton by temperature rather than date. State experiment stations in North and South Carolina, Mississippi, Arkansas, Oklahoma, Texas, Arizona, and California are cooperating in this research. If the tests work out, cotton farmers generally may begin carrying thermometers at planting time.

Natural Rubber . .

Despite the widespread use of synthetic rubber, a fifth of our total rubber requirements must still be met by natural rubber. In fact, we need more and more of it to satisfy the growing over-all rubber demand.

To help safeguard America's supply of natural rubber, much research has been done to develop sources in this hemisphere. This work is proceeding here and in Latin America along three main lines:

1. Laying a foundation for successful rubber plantings in Central and South America through cooperative research and development.
2. Breeding better guayule, a rubber-producing plant that can be grown in the U. S., and devising an efficient way to process it.
3. Improving kok-saghyz, or Russian dandelion, which grows in a wide range of climates and yields a crop of rubber in 9 months.

Latin-American countries, once exporters of wild rubber, now must import increasing amounts of Hevea rubber from the Orient to meet their own needs. If Far Eastern imports were again cut off, these countries would have to share in the hemisphere's rubber supplies and could not serve as an additional source, as they did in World War II.

Since 1940, representatives of the Bureau of Plant Industry, Soils, and Agricultural Engineering have been working to advance Hevea-rubber production in 11 countries: Bolivia, Brazil, Colombia, Costa Rica, the Dominican Republic, Guatemala, Haiti, Honduras, Mexico, Panama, and Peru.

Our scientists are cooperating with local technicians to improve cultural practices and develop better plants. Some 37,000 acres are devoted to experimental plantations and to rubber

HEVEA trees, intercropped here with pineapple, grow on many small farms in Tropical America.

a Must Crop

plantings on hundreds of farms. Emphasis has been on small-farm production, in which rubber can be grown as a cash crop.

At research stations in Brazil, Costa Rica, Guatemala, and Haiti, a defense against a leaf blight was achieved by using the famous "sandwich tree": a rootstock of one variety, a trunk of a high-producing variety, and a top from a variety resistant to leaf blight. Strains that may combine higher yield with blight resistance are being developed.

Here in the United States, technicians of the Bureau of Agricultural and Industrial Chemistry joined with the plant scientists to help establish a rubber potential within our borders. They have worked out a much improved way to extract good natural rubber from the resinous guayule shrub, a native of Mexico and Texas. Plant Industry breeders have crossed guayule with a tree-like relative found in Mexico. This, plus continued selection, has produced a plant that will yield 50 percent more rubber than the guayule available during World War II.

Breeding has improved kok-saghyz, too. This plant, discovered by the Russians in 1931, looks much like our native dandelions. The roots yield a crop of natural rubber in less than a year, whereas guayule and the Hevea tree generally take about 5 years to reach the production stage. Seed is the big unsolved problem with kok-saghyz. We have little of it, and it won't hold up in storage. Rubber from this source is expensive, so kok-saghyz is considered primarily as an emergency crop that could give us rubber in a hurry, provided seed is available.

DAIRY

Change for CHEDDAR

Cheddar-cheese makers will soon be able to cut manufacturing time in half with a new process developed by the Bureau of Dairy Industry.

This procedure takes only 2½ to 3½ hours from the time the starter is added until the curd is pressed, whereas present methods require 6½ to 7½ hours. With the improved process, factories can make two runs instead of one in a normal work day.

Dairy scientists have applied basic knowledge of chemistry, bacteriology and mechanics in this new method of turning pasteurized milk into America's most popular cheese. Much hand labor is eliminated, and some of the usual practices in producing acid, cooking, cheddaring, and salting have been dropped or changed. Factories will need to supplement their facilities with some added equipment.

Body, texture, and flavor of the new Cheddar are equal or superior to that of high-grade cheese made by present methods. Usually waxy and completely free of mechanical holes, the quick-made product is easy to slice.

Details of the procedure will be revealed at the annual meeting of the American Dairy Science Association, June 22–24 in Madison, Wis. ARA scientists H. E. Walter, A. M. Sadler, J. P. Malkames, Jr., and C. D. Mitchell cooperated in the research.

The U. S. Department of Agriculture is applying for a public-service patent that will make the process available to the public without charge.

A tenth of the country's milk goes into cheese, three-fourths of it Cheddar. Leading Cheddar-producing states include Wisconsin, Missouri, Minnesota, Illinois, Tennessee, Indiana, and New York.

More forage, better cows cut dairy costs

Studies by agricultural economists point up the fact that using more forage can mean money in the dairy farmer's pocket.

Better forage production and use, plus shifting some acreage from grain to forage, could give central Pennsylvania dairymen 10 to 15 percent more net income. In Michigan, forage improvement can result in equal milk output at 15 percent lower feed cost. A well-managed dairy farm with good pasture in South Carolina can earn more than the same acreage planted to cotton, but making the shift takes considerable capital.

This research, done cooperatively by the States and the USDA's Bureau of Agricultural Economics, gave similar results in several other States, from Alabama to Montana.

Records of 900,000 cows in dairy herd improvement associations show how owners can save on feed with high-producing animals. Feed costs for cows giving 5,000 pounds of milk a year—about the national average—was $2.70 per 100 pounds of milk But for those producing 9,000 pounds the feed cost per hundred pounds of milk was only $1.83. The average production of all association cows, as reported in September 1952, was 9,195 pounds of milk and 370 pounds of butterfat per cow.

Big Freeze *Walk-in* Refrigerator

Now is the time farmers really begin appreciating their home-made freezer-refrigerators. Many of them were built the past two winters.

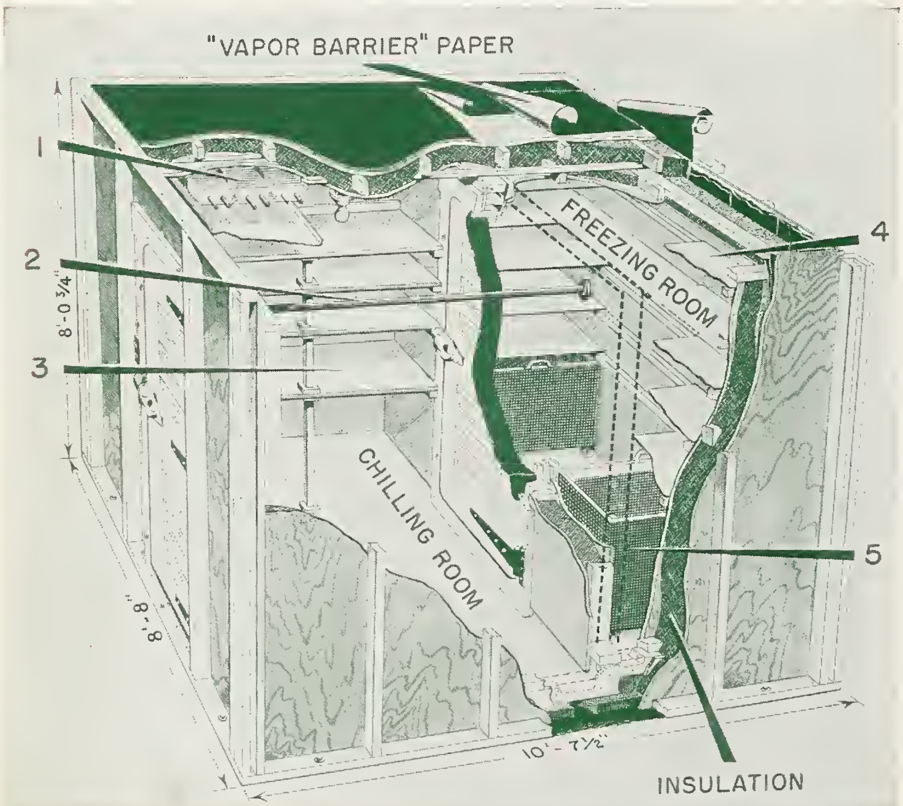
Plans for a two-temperature, walk-in refrigerator developed by ARA engineers and household-equipment specialists have been available since October 1951. Now a new design, with more freezer space for those who want it, is on the drawing board.

The original unit was developed after extensive study of farm freezing and chilling facilities in use around the country. This research was undertaken as a direct result of the demand from farmers for information on how to build walk-in refrigerators or to improve home-built facilities already in use.

Recently, with the growing popularity of food freezing, farmers have been asking for more freezing, less chilling space than they wanted originally. This is especially true of those who do some commercial freezing. The research men have designed another freezer-chiller to meet the need. Their new plans aren't ready yet but should be finished in time for farmers to build the big-freezer walk-in units this winter.

The present refrigerator (see drawing) has 250 cubic feet of chilling space (at 35° F.) and 100 cubic feet freezer space (at 0° F.). Cost of materials and equipment is about $1,200, and year-round operating costs average $4.50 a month. The chill room will cool one beef, or a large hog, or 600 pounds of produce. The freezer will freeze about 100 pounds of food per day.

DETAILS of walk-in refrigerator: (1) cooling coils in chill room, (2) rail to hang meat, (3) removable wooden shelves, (4) refrigerated metal shelves for freeze room, and (5) rolling storage bins with wire sides. Vapor-barrier paper is essential to prevent infiltration of moisture. Farmers buy metal shelves for freezer, refrigeration equipment, and doors, build rest on farm.



In the new design, space proportions are reversed. It provides 250 cubic feet for freezing, 100 for chilling, and will cost slightly more to build and operate. The larger freezing room can handle 150 pounds of food per day and has storage space for 5,000 pounds or more.

Both refrigerators are essentially man-sized, insulated boxes measuring about 7′ x 8½′ x 6½′ inside. Floors are concrete on an insulated base. An outer door opens into the chilling room, which has wooden storage shelves and a rail for hanging sides of beef or other meats. A second door leads from the chiller into the freezing compartment, where refrigerated metal shelves and rolling storage bins are provided.

Two refrigerating units are rack mounted outside the refrigerator, one for the chiller and another for the freezing room. An additional unit is required to operate the freezer provided in the new design. The entire walk-in refrigerator can be used for freezing, if desired, but operation for long periods in this manner is not recommended.

These refrigerators were developed at the Beltsville Agricultural Research Center by Earl McCracken, Harry Garver, and Paul James. Plans based on their original design can be ordered now from State extension engineers or from the USDA. The plans for the new refrigerator should be ready later this year.

Dried eggs you'll really like

Skeptical ex-servicemen of World War II will have to be shown, but the fact is that research has given the dried egg a new personality.

Today's product tastes better when cooked and keeps several times longer than the best dried eggs of 10 years ago. It makes possible much wider use of whole-egg powder.

This doesn't mean that powdered eggs will soon replace the shell variety on your breakfast table. You still can't fry a dried egg sunnyside up. But it does mean better, easier-to-use cake mixes containing whole eggs for housewives. And it helps bakers use more eggs in pastry products. Output of the new dried eggs is now several million pounds a year.

The culprit mainly responsible for objectionable flavors in dried eggs is glucose. This sugar makes up about 1 percent of egg solids. Scientists at the Bureau of Agricultural and Industrial Chemistry's Western Regional Laboratory, Albany, Calif., developed a practical means to eliminate glucose from eggs before they are dried. The process involves a 2-hour fermentation with baker's yeast.

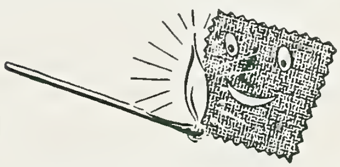
The Western Laboratory's research men found that glucose-free dried eggs keep 10 times longer than plain dried eggs and 3 times longer than acidified whole eggs, developed by the laboratory after World War II.

They also discovered how glucose behaves in dried eggs. It reacts to produce off-flavors not only with egg proteins, as expected, but also with cephalin, a phospholipid in the fatty fraction of eggs. The reaction between the aldehydic group in glucose and the primary amino group of cephalin appears to be a major cause of off-flavor development.

Certain oxidative and other reactions still limit the keeping quality of egg powder. Improvements in processing to further increase the stability of dried eggs, and to improve their physical properties from the baker's standpoint, are being sought.

Better ways to preserve eggs can mean wider markets and more stable prices for farmers, and better, more economical products for consumers.

Washable flameproof cotton



Improved flameproofing of cotton fabrics, using a chemical treatment that remains effective in the cloth through repeated launderings, was announced recently by the Bureau of Agricultural and Industrial Chemistry's Southern Regional Research Laboratory in New Orleans.

Cotton goods finished by the new process will char if subjected to fire, but they won't burst into flame and have no smoldering afterglow.

The treated fabrics retain their flameproofness after more than 15 launderings, a very severe test for this type of chemical finish. They should be useful, the laboratory's scientists believe, for curtains, draperies, upholstery, bedding, and other cotton textiles in which flame resistance has high safety value.

This finishing method, developed by W. A. Reeves and J. D. Guthrie, is the latest of several flameproofing processes now under study at the Southern Laboratory in research to improve various properties of cotton fiber, yarn, and cloth.

Development of flameproofing finishes for cotton fabrics was undertaken by the laboratory in cooperation with the Army Quartermaster Corps, which is greatly interested in flameproof military clothing. Battle experience with incendiary weapons has shown the need for improved flameproofing of fabrics for military use. This is recognized by the armed services as one of their major textile problems.

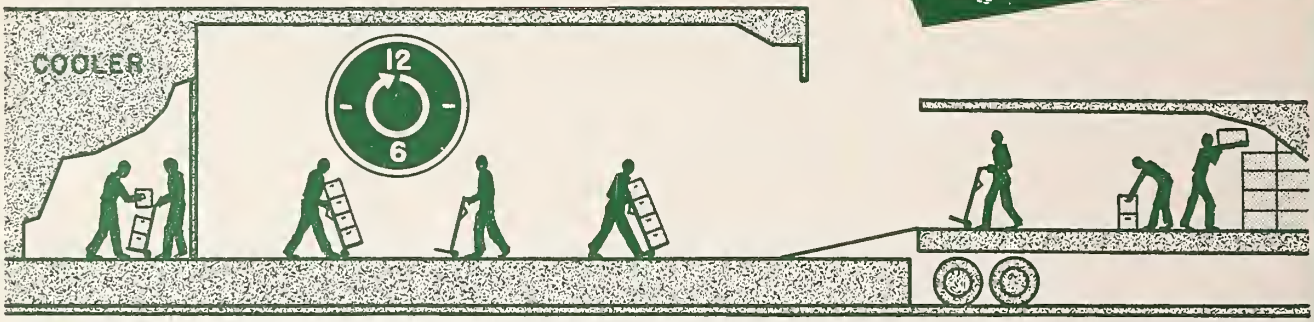
Chemicals used in the Southern Laboratory's new treatment are (1) methylolmelamine, already employed widely for creaseproofing fabrics; (2) urea, a common industrial chemical; and (3) a phosphorus-containing compound, tetrakis (hydroxymethyl) phosphonium chloride, known as THPC and now available in limited quantities for experiment.

These compounds are applied with standard textile equipment. The process is similar to commercial methods used in creaseproofing cotton. After treatment with a solution of the chemicals, the fabric is dried, cured for a few minutes at 285° F., then washed and again dried.

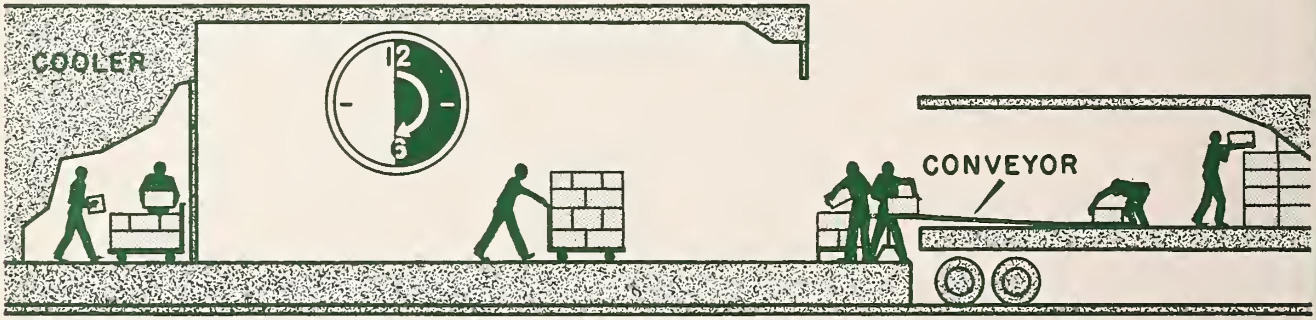
The new method of flameproofing will cost little more than some of the less permanent processes now in commercial use. Large-scale production of THPC is considered feasible, and the chemical should be relatively inexpensive to manufacture.

Information on the improved treatment and small samples of fabrics flameproofed by this process are available from the Southern Regional Research Laboratory.

Loading 500 Cases of Eggs:



12 MAN-HOURS were needed to handle 500 cases of eggs when loading was done this way. These eight men worked 1 hour and 30 minutes.



LESS THAN HALF as much labor was required to load the eggs in this way. Seven men moved 500 cases in 50 minutes, or just 5.84 man-hours.

Labor is the big item

Labor is the biggest single item in the cost of marketing farm products. Most of the money spent on labor pays for picking up and putting down products in all stages of handling, from farms to retail stores. More efficient handling methods can cut labor costs and help reduce the spread between prices paid to farmers and those paid by consumers.

Teamwork between the Production and Marketing Administration and the poultry industry has led to improved methods that are lowering the cost of handling eggs, says N. G. Paulhus, PMA marketing specialist.

One example is a recent study made at a large Midwestern plant that handles a thousand cases of eggs daily. By a simple change, this plant was able to cut in half the labor needed in egg loading. (See chart.) Even greater manpower savings could have been made, the study showed, with further improvements in equipment and methods.

A full report of this and other studies on egg handling will be available soon from the Office of Information Services, PMA.

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